DOCUMENT RESUME

ED 342 638 SE 052 381

| | |
|---|---|
| TITLE | Algebra with Introduction to Trigonometry Curriculum. |
| INSTITUTION | EASTCONN Regional Educational Services Center, North Windham, CT. |
| SPONS AGENCY | Connecticut State Dept. of Education, Hartford. Div. of Vocational, Technical, and Adult Education. |
| REPORT NO | VT-607 |
| PUB DATE | 89 |
| NOTE | 27p.; For related documents, see SE 052 379-382. |
| PUB TYPE | Guides - Classroom Use - Teaching Guides (For Teacher) (052) |
| EDRS PRICE | MF01/PC02 Plus Postage. |
| DESCRIPTORS | *Algebra; *Analytic Geometry; *Curriculum Development; Curriculum Evaluation; High Schools; *Mathematics Curriculum; Mathematics Education; *Mathematics Instruction; Minimum Competencies; Student Educational Objectives; Trigonometry; *Vocational Education; Vocational Schools |
| IDENTIFIERS | Connecticut State Department of Education; Graphing (Mathematics) |

ABSTRACT

In 1988-89 the Connecticut Vocational-Technical School System initiated a program for the ongoing review and upgrading of all trade and academic curricula used in the system's 17 schools to insure that each curriculum is consistent with current standards. Every 3 years the Curriculum Steering Committee for the trade or academic subject conducts a review and an analysis to identify outdated content, approaches or materials. The revised curriculum incorporates the latest thinking of instructors who teach the subject, suggestions from authorities in the mathematics field, and current instructional approaches in the field of education. This curriculum is intended as a plan for learning algebra with trigonometry and an aid to the mathematics instructor to prepare students for membership in society. The document is separated into several sections: the Vocational-Technical School Mathematics Sequence; Career Relationships and Requirements; Instructor's Goals; Students' General Competencies; a Common Core of Learning; Personal Goals for Students; and a series of 14 algebra and trigonometry units. Each unit provides suggested instructional time, unit objectives, and a list of student competencies required of students after completing the unit. The units are: (1) Radical Expression, Elimination, Complex Fractions; (2) Factoring; (3) Scientific Notation, Consecutive Integers, and Rational Equations; (4) Graphical Solutions, Equation of a Line; (5) Multiplication of Radicals, Division of Polynomials, and System of Equations; (6) Solutions of Quadratic Equations by Factoring, Intercept-Slope Method of Graphing; (7) Multiplicative Property of Inequality, Uniform Motion Problems, Difference of Two Squares; (8) Pythagorean Theorem, Distance, Uniform Motion, Square Roots, and Rounding; (9) Absolute Value Inequalities, Rational Equations; (10) Equation of a Line through Two Points, Functional Notation; (11) Parallel Lines, Equation of a Line with Given Slope, Radical Slope Equations, Formula; (12) Absolute Value Inequalities, Multiplication of Radical Expressions, Linear Inequalities; (13) Square Roots (Quotient Theorem), Trinomial Factoring, The Quadratic Formula; (14) Trigonometry of the Right Triangle. A textbook and computer software are suggested. (MDH)

CT89CD03

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VT-607

# ALGEBRA WITH TRIGONOMETRY

VOCATIONAL-TECHNICAL SCHOOL SYSTEM
CONNECTICUT DEPARTMENT OF EDUCATION

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# ALBEGRA WITH INTRODUCTION TO TRIGONOMETRY

## CURRICULUM

PREPARED BY EASTCONN
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PREPARED FOR:

CONNECTICUT STATE DEPARTMENT OF EDUCATION
DIVISION OF VOCATIONAL, TECHNICAL AND ADULT EDUCATION
VOCATIONAL-TECHNICAL SCHOOL SYSTEM
MIDDLETOWN, CONNECTICUT

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THIS PROJECT WAS SUPPORTED BY FUNDS MADE AVAILABLE TO CONNECTICUT
THROUGH P. L. 98-524

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1989

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## FOREWORD

In 1988-89 the Connecticut Vocational-Technical School System initiated a program for the ongoing review and upgrading of all trade and academic curricula used in the System's seventeen schools to insure that each curriculum is consistent with current standards. Each curriculum is first reviewed by the appropriate Curriculum Steering Committee. That is done during the third year following the curriculum's last revision. The Curriculum Steering Committee for the trade or academic subject conducts a review and an analysis to identify outdated content, approaches, or materials. Any deficiencies are noted. During the following year a sub-committee of the Steering Committee prepares a revision of the curriculum incorporating all required changes.

This publication is the result of such a revision. The curriculum incorporates (a) the very latest thinking of instructors who teach the subject, (b) suggestions from authorities in the mathematics field, and (c) current instructional approaches in the field of education.

Special appreciation is extended to the instructors who provided input prior to the beginning of the curriculum revision. We also appreciate the suggestions and significant contribution of Ronald E. Brann, Consultant, Connecticut State Department of Education, Vocational, Technical & Adult Education, Vocational-Technical School System.

Jerry C. Bencivenga, Consultant
Vocational-Technical School System

John Bruno, Steering Committee Chairman
August 1989

# INTRODUCTION

The following curriculum is intended as a plan for learning and an aid to the instructor whose responsibility it is to teach mathematics and to prepare students for involved and productive membership in society. The curriculum document consists of several sections. Each of the sections is explained below.

Career Relationships and Requirements. The instructor is the key person in the student's preparation for adult society. This section of the curriculum reminds the Instructor of some career related informational sources which should be shared with the students.

Common Core of Learning (CCL). Each of the General and Personal Goals for Students directly relates to a component of Connecticut's Common Core of Learning. However, the instruction and experiences which are provided to assist a student toward achievement of a competency may address other CCL components in varying degrees. The CCL Matrix illustrates the full range of CCL components which are effected. Instructors should refer to the complete list of CCL components found in the Appendices.

Instructor's Goals. These are the competencies expected of every successful student in the program. Competencies are stated in terms of expected student outcomes. All subsequent instructional decisions should show a relationship to one or more of these competencies.

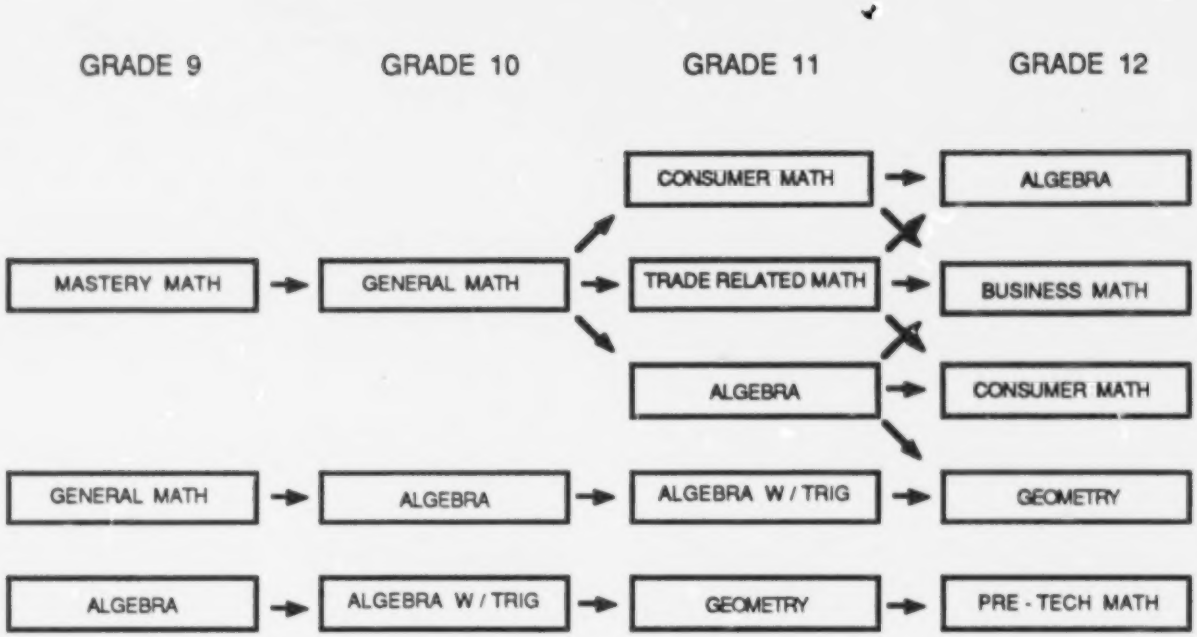
Personal Goals for Students. A successful citizen and tradesperson becomes such through the mastery of essential knowledge and skills plus the internalization of positive attitudes and values. "Personal Goals for Students" calls attention to some behaviors which should be demonstrated by responsible citizens.

Course Outline. Course content, specific objectives, and related activities are organized into coherent blocks of instruction. They may be called units or they may simply be identified by a designated period of time. Contained within each block are the differentiated Student Competencies and an outline of the essential content necessary for achievement of them. The units contain suggested activities and suggested approaches to assessment. In all cases, they are suggestions not prescriptions. The instructor is expected to commit to the goals and competencies but alternative means may be employed to achieve them.

Appendices. The appendices offer brief lists of resources appropriate to the successful completion of the program. In addition to the obvious use of these pages, the instructor may refer to the appendices when ordering supplies.

**VTSS**

**MATHEMATICS SEQUENCE**




All voc-tech schools should schedule math students by ability. When students need to learn a new math skill out of sequence for use in their shop, the shop instructor should teach it during theory.

We encourage our students to challenge themselves with advanced course work to stretch the limits of their ability and not just accept minimum achievement as a goal.

In addition, scheduled computer-assisted math is available in all schools to tutor students in need.

Finally, students should not be tracked in any one sequence. Any students showing success in a mathematics course should be considered for advanced courses. For this reason, classes are not limited to a single grade.

3-17-89

## CAREER RELATIONSHIPS AND REQUIREMENTS

Successful completion of this course provides a student with the basic understanding of the math skills needed to enhance their career. He or she should also have an understanding and appreciation of the vital role of mathematics in everyday transactions. Through this knowledge the student will be able to benefit as a worker, consumer or business person, and be a more productive citizen. The mathematical principles constitute a foundation which the student can continue to learn and add to his/her individual knowledge. Students who wish to consider career options in mathematics should be encouraged to consult the Connecticut Information System (COIS) and the Occupational Outlook Handbook (United States Department of Labor) to identify related occupations and their requirements.

## INSTRUCTOR'S GOALS

The Instructor will:

1. Plan learning experiences which consist of a logical introduction, sufficient development and guided practice for basic understanding and a summarizing conclusion.

2. Select delivery strategies which take into account the different interests, abilities, learning styles, and expectations of Vocational-Technical School students;

3. Plan and present lessons that demonstrate how mathematics relates to the student's selected vocation or trade area.

4. Plan instruction geared to ability levels of the students in each class.

5. Employ a variety of instructional techniques.

6. Use a variety of evaluative tools and techniques.

7. Encourage students to use their creativity and initiative.

8. Present learning experiences in such a way as to elicit higher-level thinking and critical thinking;

## STUDENTS' GENERAL COMPETENCIES

The Student will:

1. Find roots of numbers and algebraic expressions or simplify if root cannot be found.
2. Perform computations using exponents.
3. Solve quadratic equations.
4. Find the root(s) of an equation.
5. Solve systems involving quadratics.
6. Solve inequalities.
7. Write ratios and reduce ratios.
8. Solve proportions.
9. Solve problem involving variation.
10. Identify the six trigonometric ratios.
11. Solve for unknowns in right triangle problems.
12. Understand how mathematics relates to the student's selected vocation or trade area.

CORRELATIONS OF TRADE/SUBJECT COMPETENCIES
WITH CONNECTICUT'S COMMON CORE OF LEARNING

| LIST OF STUDENT COMPETENCIES OR ANTICIPATED OUTCOMES | RELATED COMMON CORE OF LEARNING COMPONENTS | | |
|---|---|---|---|
| TRADE/SUBJECT: **ALGEBRA WITH TRIG** | ATTITUDES AND ATTRIBUTES | SKILLS AND COMPETENCIES | UNDERSTANDINGS AND APTITUDES |
| Be able to find roots of numbers and algebraic expressions or simplify if root cannot be found. | | D3 | F1, F7 |
| Be able to perform computations using exponents. | | D3 | |
| Be able to solve quadratic equations. | | | F7 |
| Be able to find the root(s) of an equation. | | D3 | |
| Be able to solve systems involving quadratics. | | E8, E9 | F7 |
| Be able to solve inequalities. | | E3, E5 | |
| Be able to write ratios and reduce ratios. | | D3 | F1 |
| Be able to solve proportions. | | D3 | |
| Be able to solve problems involving variation. | | E5,E6,E7, E7,E8,E9 | F7 |
| Be able to identify the six trigonometric ratios. | | D3 | F7 |
| Be able to solve for unknowns in right triangle problems. | | D3,E6,E7, E7,E8,E9 | F7 |
| Understand how mathematics relates to the student's selected vocation or trade area. | A3, D3 | F1 | B3,B4,B5, B6,F2,F3 |

## PERSONAL GOALS FOR STUDENTS

The Student will demonstrate a willingness to:

1. Do assigned tasks without constant supervision.
2. Work as a team member and assist others.
3. Observe safety rules.
4. Maintain books, equipment, and work stations.
5. Contribute to maintaining a positive educational environment within the classroom.

UNIT I

RADICAL EXPRESSIONS, ELIMINATION, COMPLEX FRACTIONS

Suggested Instructional Time: 5 days

Unit Objective: After completing this unit, the student should be able to add like radical expressions by adding the numerical coefficients, simplify radical expressions, solve systems of linear equations by the elimination method, and simplify complex fractions.

Student Competencies:

After completing this unit, all students should be able to:

1. Add like radical expressions. Radical expressions that have the same index and the same radicand designate the same number and are like terms. Add like radical expressions by adding the numerical coefficients.

2. Simplify radical expressions.

3. Solve systems of equations by the elimination method.

4. Simplify complex fractions. The student should add all expressions in the numerator and add all expressions in the denominator. Then the student finishes by multiplying both the numerator and the denominator by the reciprocal of the denominator.

UNIT II

FACTORING

Suggested Instructional Time: 4 days

Unit Objective: After completing this unit, the student should be able to factor trinomials, and factor binomials that are the difference of two squares.

Student Competencies:

After completing this unit, all students should be able to:

1. Factor quadratic trinomials. The word quadratic indicates that the highest power of the variable is 2.
2. Factor trinomials with common factors. Students should first factor out the common factor, and then factor one or both of the resulting expressions.
3. Factor binomials that are the difference of two squares.

UNIT III

SCIENTIFIC NOTATION, CONSECUTIVE INTEGERS, AND RATIONAL EQUATIONS

Suggested Instructional Time: 9 days

Unit Objective: After completing this unit, the student should be able to write numbers in scientific notation, solve consecutive integer word problems, solve rational equations, and multiply and divide very large numbers using scientific notation.

Student Competencies:

After completing this unit, all students should be able to:

1. Write numbers using scientific notation.
2. Solve consecutive integer word problems.
3. Solve consecutive odd and consecutive even integer word problems.
4. Solve fraction and decimal word problems.
5. Solve rational equations.
6. Solve systems of equations with subscripted variables.
7. Use scientific notation in problems that require the multiplication and division of very large or very small numbers.

UNIT IV

GRAPHICAL SOLUTIONS, EQUATION OF A LINE

Suggested Instructional Time: 5 days

Unit Objective: After completing this unit, the student should be able to graph solutions of systems of linear equations. The student should be able to write the equation of a line. In addition, the student should be able to solve coin word problems.

Student Competencies:

After completing this unit, all students should be able to:

1. Graph solutions of systems of linear equations.
2. Write the equation of a vertical or horizontal line.
3. Write the equation of a line in the slope-intercept form.
4. Solve word problems that contain two statements about quantities that are equal. Turn each of the statements into an equation that has two variables. Solve the equations by using either substitution or elimination. The first problems of this kind are called coin problems.

UNIT V

MULTIPLICATION OF RADICALS, DIVISION OF POLYNOMIALS,
AND SYSTEM OF EQUATIONS

Suggested Instructional Time: 7 days

Unit Objective: After completing this unit, the student should be able to multiply radicals, divide polynomials, and solve systems of equations through substitution when one equation must be rearranged.

Student Competencies:

After completing this unit, all students should be able to:

1. Multiply radical expressions. If m and n are nonnegative real numbers, then

2. Divide polynomials by monomials and binomials.

3. Solve systems of equations using the substitution method. It may become necessary to rearrange one of the equations before the necessary substitutions can be accomplished. At times, the student will have to rearrange the equation that relates the time variables before substitution.

4. Divide polynomials. Write polynomials in descending order of the variable. When a dividend is missing a term, insert the term and give it a coefficient of zero.

## UNIT VI

## SOLUTION OF QUADRATIC EQUATIONS BY FACTORING, INTERCEPT-SLOPE METHOD OF GRAPHING

Suggested Instructional Time: 6 days

Unit Objective: After completing this unit, the student should be able to solve quadratic equations by factoring, solve value problems, and graph lines through the intercept method of graphing.

Student Competencies:

After completing this unit, all students should be able to:

1. Solve quadratic equations by factoring.
2. Use two equations in two variables to solve value problems. These are similar to coin problems discussed in Unit IV.
3. Use the intercept and the slope of the line to get an accurate graph.

UNIT VII

MULTIPLICATIVE PROPERTY OF INEQUALITY, UNIFORM MOTION PROBLEMS, DIFFERENCE OF TWO SQUARES

Suggested Instructional Time: 8 days

Unit Objective: After completing this unit, the student should be able to apply the multiplication rule to inequalities, solve uniform motion problems, and solve an equation of the form $p^2 = q^2$.

Student Competencies:

After completing this unit, all students should be able to:

1. Apply the multiplication rule to inequalities. When every term on both sides of an inequality is multiplied by a negative number, the inequality symbol must be reversed.

2. Solve uniform motion word problems about equal distances.

3. Solve uniform motion word problems of the form $D_1 + D_2 = N$.

4. Solve an equation of the form $p^2 = q^2$. The theorem that describes the solution is called difference of two squares theorem. If p and q are real numbers and if $p^2 = q^2$, then $p=q$ or $p=-q$.

## UNIT VIII

## PYTHAGOREAN THEOREM, DISTANCE, UNIFORM MOTION, SQUARE ROOTS, AND ROUNDING

Suggested Instructional Time: 8 days

Unit Objective: After completing this unit, the student should be able to use the Pythagorean Theorem to solve right triangles, find the distance between two points, solve uniform motion problems and unequal distances, find square roots of large numbers, and review rounding.

Student Competencies:

After completing this unit, all students should be able to:

1. Solve a right triangle using the Pythagorean Theorem.
2. Find the distance between two points given the coordinates of the points.
3. Solve uniform motion problems that tell us that one person or object traveled a distance that is greater by a specified amount than the distance traveled by another person or object.
4. Simplify square roots of large numbers.
5. Round off any numeral to any digit.
6. Use square root tables to approximate the square root of numerals.

UNIT IX

ABSOLUTE VALUE INEQUALITIES, RATIONAL EQUATIONS

Suggested Instructional Time: 8 days

Unit Objective: After completing this unit, the student should be able to use solve and graph absolute value inequalities, and solve rational equations whose terms have variables in one or more denominators.

Student Competencies:

After completing this unit, all students should be able to:

1. Solve and graph absolute value inequalities.

2. Solve rational equations whose terms have variables in one or more denominators. The student should:

   a. List those values of the variable that would cause any denominator to equal zero.

   b. Multiply every numerator by the least common multiple of the denominators.

   c. Cancel the denominators.

   d. Solve the resulting equation.

UNIT X

EQUATION OF A LINE THROUGH TWO POINTS, FUNCTIONAL NOTATION

Suggested Instructional Time: 6 days

Unit Objective: After completing this unit, the student should be able to find the equation of a line, when given two points, understand the definitions of Function, Domain, Image, and Range, and be able to understand and use functional notation.

Student Competencies:

After completing this unit, all students should be able to:

1. Write the equation of a line, when given two points.
2. Determine whether a diagram, graph, or set of ordered pairs designates a function.
3. Read and write functional notation.

UNIT XI

PARALLEL LINES, EQUATION OF A LINE WITH GIVEN SLOPE,
RADICAL EQUATIONS, SLOPE FORMULA

Suggested Instructional Time: 8 days

Unit Objective: After completing this unit, the student should be able to find the equation of the line through a point that is parallel to a given line, find the equation of the line with a given slope, and through a given point. In addition, the student should be able to solve a radical equation in which the radical must be isolated, and finally, should be able to find the slope of a line that passes through two given points.

Student Competencies:

After completing this unit, all students should be able to:

1. Find the equation of the line through a point that is parallel to a given line. The equation of one line is given. A point on a parallel line is given. The student must find the equation of the line that has the given point on it.

2. Find the equation of a line with a given slope and through a given point.

3. Solve a radical equation in which the radical must be isolated:

   Solve

4. Find the slope of a line that passes through two given points.

UNIT XII

ABSOLUTE VALUE INEQUALITIES, MULTIPLICATION OF RADICAL EXPRESSIONS, LINEAR INEQUALITIES

Suggested Instructional Time: 5 days

Unit Objective: After completing this unit, the student should be able to graph inequalities that involve conjunctions and disjunctions, multiply radical expressions by the foil method, and graph inequalities in the Cartesian Coordinate System.

Student Competencies:

After completing this unit, all students should be able to:

1. Graph inequalities where there are two restrictions on the numbers that can be used. When two restrictions must be satisfied, the word "and" designates compliance with both restrictions. When either of two restrictions must be satisfied, the word "or" designates that a solution of either restriction is all that is necessary.

   Examples: Graph $x \quad -1$ and $x \quad 4$.
   Graph $x \quad -1$ or $x \quad 2$.

2. Multiply radical expressions by the foil method.

   Example: $(2 + 2)(3 + 8)$

3. Graph linear inequalities in the cartesian Coordinate System.

UNIT XIII

SQUARE ROOTS (QUOTIENT THEOREM), TRINOMIAL FACTORING,
THE QUADRATIC FORMULA

Suggested Instructional Time: 5 days

Unit Objective: After completing this unit, the student should be able to apply the quotient theorem for square roots, factor advanced trinomials, and solve quadratic equations using the quadratic formula.

Student Competencies:

After completing this unit, all students should be able to:

1. Apply the quotient theorem for square roots. The student should be able to write

   in simplified form, and in simplified form.

2. Factor trinomials in which the coefficient of the $x^2$ term is not 1 and the trinomial cannot be reduced to this form by factoring a common factor.

   Example: factor $2x^2 - 7x - 15$.

3. Use the quadratic formula to determine the roots of a quadratic equation.

## UNIT XIV

## TRIGONOMETRY OF THE RIGHT TRIANGLE

Suggested Instructional Time: 7 days

Unit Objective: After completing this unit, the student should be able to understand and apply elementary trigonometric principles and techniques.

Student Competencies:

After completing this unit, all students should be able to:

1. Define the six trigonometric functions.
2. Understand reciprocal relations among the trigonometric functions.
3. Relate the trigonometric functions of complementary angle: confunctions.
4. Find the measure of an angle, correct to the nearest degree, when a function value is given.
5. Understand and use trigonometric functions of $30^{\circ}$, $45^{\circ}$, and $60^{\circ}$.
6. Find all the trigonometric functions of an acute angle when the value of one of them is given.
7. Use trigonometric functions to solve right triangles.
8. Solve navigation problems involving bearings and courses.
9. Solve more difficult problems involving two right triangles.

## APPENDIX A

## COMPUTER RESOURCE SOFTWARE

| Item | Software | | Computer |
|---|---|---|---|
| 1. | Math Blaster | | Mac |
| 2. | Math Blaster Plus | | Apple IIGS/IIe |
| 3. | Algablaster | | Apple IIGS |
| 4. | Simple Accounting | | Mac |
| 5. | Math Talk | | Mac |
| 6. | Jumping Math Flash | | Apple IIGS |
| 7. | Math Type | | Mac |
| 8. | MacDraft | | Mac |
| 9. | Pict-O-Graph | | Mac |
| 10. | Geometry | | Mac |
| 11. | Calculus | | Mac |
| 12. | Problem Solving in Algebra Intro and | Lessons 1 - 7 | Apple II GS/IIe |
| 13. | Problem Solving in Algebra | Lessons 8 - 14 | Apple II GS/IIe |
| 14. | Problem Solving in Algebra | Lessons 15 - 21 | Apple II GS/IIe |
| 15. | Problem Solving in Algebra | Lessons 22 - 30 | Apple II GS/IIe |
| 16. | Problem in Algebra | Lessons 31 - 38 | Apple II GS/IIe |
| 17. | Geometry - Funky Chicken | | Apple II GS/IIe |
| 18 | Geometry - Exploring Triangles | | Apple II GS/IIe |
| 19. | Estimation - Estimation Invasion | | Apple II GS/IIe |
| 20. | Estimation - Round up, Round down | | Apple II GS/IIe |
| 21. | Math Skills - Junior High Level | | Apple II GS/IIe |
| 22. | Math Skills - Elementry Level | | Apple II GS/IIe |

## APPENDIX B

## RECOMMENDED TEXTBOOKS

John H. Saxon, Jr. Algebra I, An Incremental Development. Norman Oklahoma: Saxon 1989